Shaping the Future

Positioning the Laboratory for the Future

In 1999, we faced major challenges both to our programs and to the way we operate. A number of important issues concerning Laboratory operations and programs arose during the year. They have required the special attention of management, who is working closely with DOE and the University of California toward their resolution. Actions we are taking today—together with our research accomplishments, planning activities, significant partnerships, and exceptional science and technology—position the Laboratory for the future.

Security and Safety Improvements

In 1999, our efforts to continuously improve Laboratory operations focused on security and safety. Recent events have reinforced the prime importance of security at the DOE nuclear weapons laboratories. We are taking specific actions to provide even greater protection of critical assets at Livermore, implement state-of-the-art computer security, and expand our counterintelligence program. We are also aggressively implementing DOE's Integrated Safety Management System to improve safety performance and management at Livermore. Our policy is that safety of both workers and the public has the highest priority.

When construction is completed, the National Ignition Facility will provide crucial support to the Stockpile Stewardship Program, make possible fusion ignition and burn experiments, and create opportunities to advance science in many areas through groundbreaking experiments.

A San Francisco Bay Area high school teacher learns how to rapidly grow crystals during one of the Laboratory's science education programs. She now conducts workshops for other teachers.

Congresswoman Ellen Tauscher frequently meets with technical staff to discuss national security issues as well as science education and advancement of women and minorities in technical fields.

Program Planning

The future direction of the Laboratory is guided by evolving national priorities. In addition to internal planning activities, we participate in significant planning efforts with our major sponsors. Livermore's priorities are spelled out in the strategy document, *Creating the Laboratory's Future*, and the *Laboratory's Institutional Plan FY 2000–2004*.

In addition, the Long-Range Strategy Project continued into its second and last year. The project—through the effort of about 20 of our early- to mid-career scientists and engineers—considered the potential advances in science and technology and prospects for Livermore over the next 10 to 20 years.

Major Partnerships for Mission Success

Increasingly, Livermore's technical achievements are the result of major partnerships with industry, academia, and other laboratories. Partnerships and collaborations help us accomplish our programmatic goals more efficiently and cost effectively. They also provide a mechanism for commercializing and returning for broad public benefit the technological advances made at the Laboratory.

Award-Winning Science and Technology

Outstanding scientific and technical achievements ultimately define the Laboratory and chart its future. Breakthrough accomplishments, critical to Livermore's success, are the product of a quality staff—both individual and team efforts. Frequently such achievements lead to outside recognition, such as the many awards garnered in 1999.

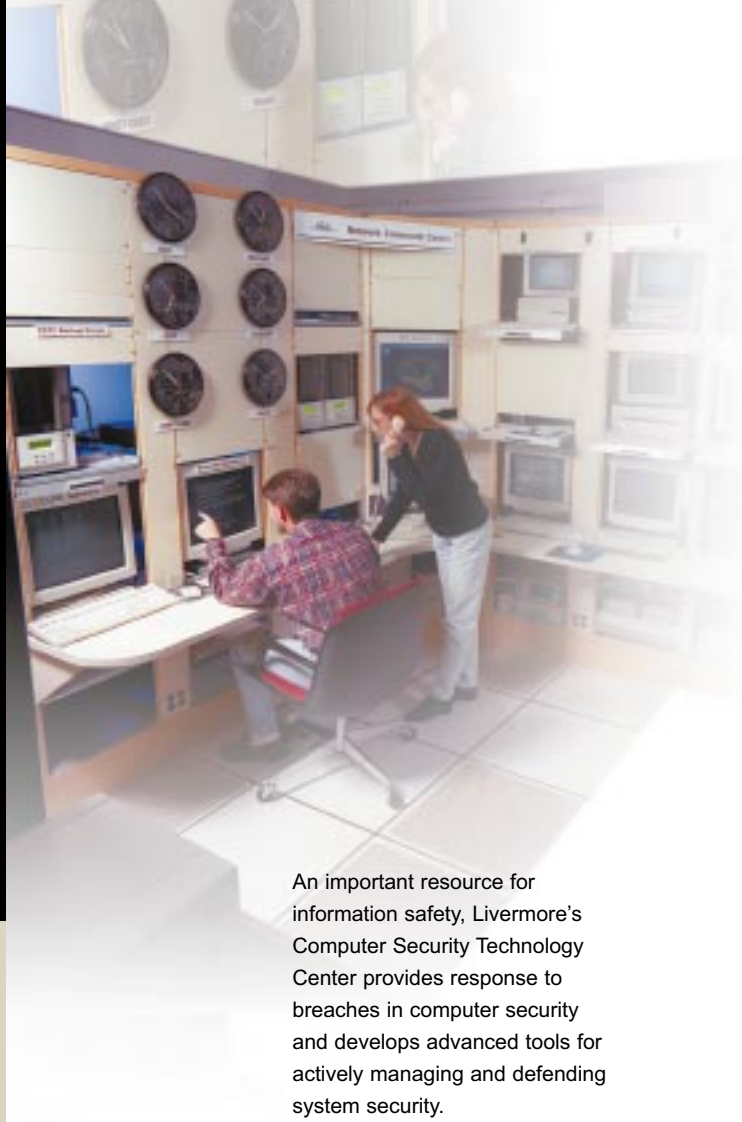
A Quality Workforce

Livermore's principal asset is its quality workforce. Our achievements are the product of a highly talented, productive, motivated, flexible staff that is committed to the Laboratory's goals. We strive for a workforce that reflects the diversity of California and the nation. And we seek to provide a work environment in which all employees can contribute to their fullest and feel valued for their role.

Secure, Safe Operations and a Good Neighbor

Security and safety are the most important considerations in day-to-day operations. Protection of sensitive information, nuclear materials, and other valuable assets at the Laboratory is a critically important responsibility. So is safety. The Laboratory is committed to providing every employee and the community with a safe and healthy environment in which to work and live. We are implementing DOE's operational concept, Integrated Safety Management, to improve safety awareness and ensure that safety stays a top priority.

Environmental protection is also an important aspect of our operations and our commitment to being a good neighbor. We are making great strides in cleaning up the Livermore site. We broadly contribute to the high-tech, global-outlook atmosphere of the region. Our technical expertise, science education efforts, and the many volunteer activities by Laboratory employees are important parts of being a good neighbor.



An important resource for information safety, Livermore's Computer Security Technology Center provides response to breaches in computer security and develops advanced tools for actively managing and defending system security.

Laboratory Improves Security Performance

Working closely with Secretary Richardson and other senior DOE managers, Livermore, Los Alamos, and Sandia national laboratories defined and expeditiously executed in 1999 a series of measures to tighten security. Protection of sensitive information and special nuclear materials at the laboratories is vitally important, and we are using increasingly sophisticated measures to provide it. All facets of our security triad—physical security, computer security, and counterintelligence—were thoroughly reviewed during the year. Steps are also being taken to implement tighter personnel security, including limited use of polygraph testing. Through new investments, revised procedures, and a greater security awareness by all employees, the Laboratory has adjusted to new security threats and concerns and addressed identified weaknesses. In December 1999, each of the three laboratories was rated "satisfactory" in overall security performance—the highest on a three-tiered rating scale.

Integrated Safety Management Off to Good Start

Livermore is implementing DOE's Integrated Safety Management (ISM) System based on a set of work standards that were developed in partnership with DOE's Oakland Operations Office and the University of California. The Work Smart Standards were accepted, and ISM implementation began in August 1999. We have set a goal—safety performance comparable to the best of our peers—through top management leadership, clear definitions of responsibilities

and performance expectations, and accountability. At Livermore, we have tended to focus our attention on special hazards associated with high-technology research projects. However, we can and must do better at preventing minor accidents connected with day-to-day activities.

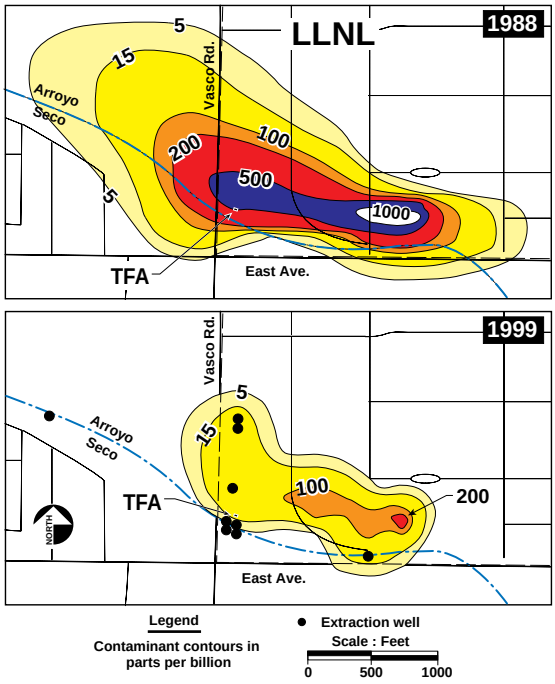
Training in ISM was completed by all employees in September. Livermore's implementation of ISM is currently undergoing verification by DOE. In a two-week-long review of the first phase, in December 1999, the verification team noted a strong ISM commitment by senior managers and identified a number of noteworthy accomplishments.

Groundwater Cleanup Way Ahead of Schedule

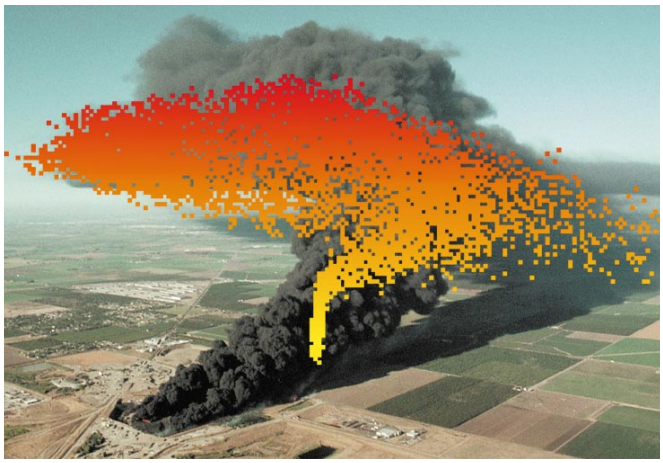
In July 1999, the Laboratory treated its billionth gallon of groundwater contaminated with chemical solvents. Ten years into the cleanup process, more than 425 kilograms of contaminant have been removed. We predict that the work can be completed almost 20 years ahead of schedule. Discarded solvents used in the 1940s while the site was a Naval Air Station and during early Laboratory operations seeped into the groundwater. A contaminated plume of groundwater stretching almost one-quarter mile beyond the Laboratory's perimeter was discovered in the 1980s. Although contamination was not a health risk to the surrounding community, cleanup began in 1989. Now the plume's outer edge in the shallowest water-bearing zone has been pulled back to within yards of the site boundary. Most of the contamination that remains is close to the regulatory limit.

Laboratory Employees Donate $1.2 Million

The annual campaign to Help Others More Effectively (HOME) raised for Bay Area and Central Valley charity organizations $1.2 million in 1999, breaking last year's record of $1 million. HOME is but one example of many outreach activities that include employee participation in community economic development organizations; environmental, health, and safety working groups; and educational activities such as science fairs and student and teacher programs.



A plume of contaminated groundwater that is beneath the Laboratory has been shrunk much faster than originally predicted using innovative solar-powered treatment units and fixed treatment facilities.



Livermore's Atmospheric Release Advisory Capability (ARAC) responds to atmospheric release emergencies worldwide. After a large fire began in a tire disposal pit near Tracy, California, we forecasted smoke dispersion and particulate concentrations in the Central Valley, thus helping California state agencies to alleviate the public's concerns about health effects.

New Capabilities through Partnerships

Livermore's partnering activities span a wide range—from very-large-scale strategic alliances to licensing of individual technologies, academic research, and support for the small business community. Partnerships and collaborations often help us accomplish our programmatic goals more efficiently and cost effectively.

The high-power solid-state green laser developed at the Laboratory has a variety of precision machining applications because of its exceptional performance and reliability compared with those of commercial copper-vapor lasers. It also can be used to pump ultrashort-pulse lasers, create laser displays, and treat disfiguring skin conditions such as port-wine stains. The technology won an R&D 100 Award.

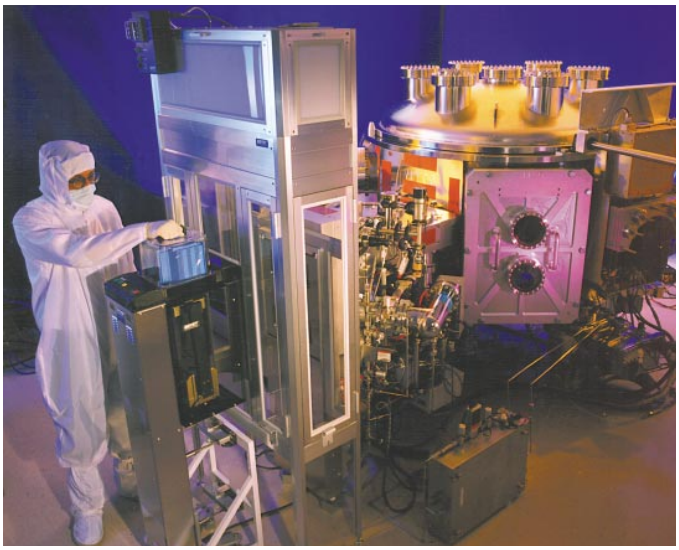
Technology Development with Industry

The Laboratory is acquiring mission-critical capabilities through major partnerships with U.S. industry, such as the Accelerated Strategic Computing Initiative and construction of the National Ignition Facility. We also enhance critical capabilities needed at the Laboratory for our national security mission through partnerships. In areas such as health care and environmental remediation, we "spin off" technologies for public benefit through cooperative research and development agreements (CRADAs) and licensing. Our many and varied interactions with U.S. industry are exemplified by Livermore's 98 active licensing agreements, 194 reported inventions, 105 patent applications, and 76 issued patents in fiscal year 1999.

Improving Designs and Measurements for EUVL

Teamed together as a Virtual National Laboratory (VNL), researchers from the Lawrence Livermore, Sandia, and Lawrence Berkeley national laboratories are working with an industrial consortium to develop the next-generation technology for semiconductor manufacturing. We are pursuing extreme-ultraviolet lithography (EUVL) as a means for etching ultrathin patterns into silicon chips with a hundredfold performance improvement over those produced with today's technology. The research and development effort by the VNL is a $250-million, multiyear CRADA partnership with the EUV LLC (Limited Liability Corporation) consortium consisting of Intel, AMD, Motorola, and Micron.

The VNL is currently focused on building and integrating the necessary technologies into an engineering test stand that will function as a prototype EUVL system. Livermore leads the efforts in the test stand's optical systems and components, thin films, masks, and submicrometer



The Ultra Clean Ion Beam Sputter Deposition System, developed at the Laboratory, is used to produce precise, uniform, highly reflective lithography masks. A key requirement of the next-generation lithography system is that it produce virtually defect-free masks. The system contributes fewer than 0.1 defect per square centimeter to each mask. The ultimate goal for extreme ultraviolet lithography is to add no more than 0.001 defect per square centimeter to a finished wafer blank.

metrology. In support of EUVL, further development of Livermore's precision deposition system won a 1999 R&D 100 Award. This year, shield design and other operational improvements were also made.

Optics teams are also working on advanced designs for projection optics, the optical heart of the lithographic exposure system. In addition, the Livermore metrology team is improving the capability to measure errors—from 0.35 to 0.15 nanometer—in the overall surface shape of aspherical optics.

PEREGRINE Goes Commercial

PEREGRINE, a revolutionary tool for analyzing and planning radiation treatment for cancer patients, will be appearing in hospitals within the next few years. Livermore has selected the NOMOS Corporation as a partner to transfer this unique system from the Laboratory into medical clinics. An R&D 100 Award winner in 1999, PEREGRINE will help a doctor to plan radiation treatment on a patient-specific basis using a readily affordable PC-like machine. Compared with other dose calculation methods in current use, PEREGRINE can more exactly estimate the radiation being delivered to a tumor and nearby tissue because the modeling explicitly accounts for inhomogeneities in the body such as air, muscle, and bone that are identified on the patient's computed tomography (CT) scan.

Radar Technology Patents Upheld

After reexamination, the U.S. Patent and Trademark Office upheld all 20 original claims by the Laboratory in its patent for the micropower impulse radar technology, or MIR. The versatile technology has the potential for enabling a wide range of low-cost instrumentation, and the Laboratory has entered into 28 licensing agreements with companies that want to use MIR in applications.

Livermore and other DOE researchers are applying laser-based processing techniques to the production of plastic flat-panel displays. In this project for the Defense Advanced Research Projects Agency, thin-film transistors are applied to thin, flexible plastic sheets in a fabrication process that combines low-temperature deposition techniques with the use of ultraviolet pulsed beams so precise and fast that the plastic does not melt.

Award-Winning Science and Technology

1999 Gordon Bell Awards

At the Supercomputing '99 Conference, the Gordon Bell Award for best performance was presented to a team of researchers from Livermore, the University of Minnesota, and IBM. Laboratory recipients recognized for their application of high-performance computers to scientific and engineering problems included Bill Dannevik, Ron Cohen, Art Mirin, Bruce Curtis, Andris Dimits, Mark Duchaineau, Don Eliason, and Dan Schikore.

Livermore (represented by David Keyes) also shared a 1999 Gordon Bell Award "special" prize with Old Dominion University and NASA for a simulation that obtained an unprecedented level of performance on an unstructured grid application.

1999 R&D 100 Awards

Bob Stoddard and Ted Wieskamp for the Optical Modulator-Switch.

Muriel Ishikawa, Ronald Lougheed, Kenton Moody, Winifred Parker, Tzu-Fang Wang, and Lowell Wood for the Gamma Watermark.

Isaac Bass, Jim Chang, Curt Cochran, Ernest Dragon, Christopher Ebbers, and the U.S. Enrichment Corporation for the Diode-Pumped Solid-State Green Laser.

Craig Brooksby, George Caporaso, Roy Hanks, Steve Hawkins, Brad Hickman, Hugh Kirbie, Bryan Lee, Craig Ollis, Rob Saethre, and Bechtel for the Advanced Radiographic Machine modulator.

Jim Folta, Fred Grabner, Gary Heaton, Gary Howe, Richard Levesque, Claude Montcalm, Mark A. Schmidt, Eberhard Spiller, Stephen Vernon, Christopher Walton, Marco Wedowski, and George Wells for the Precision Deposition System.

Christine Hartmann Siantar, Paul Bergstrom, Bill Chandler, Lila Chase, Larry Cox, Tom Daly, Don Fujino, Dewey Garrett, Brian Guidry, Steve Hornstein, Ron House, Don Jong, Dave Knapp, Sarita May, Ed Moses, Ralph Patterson, Clark Powell, Jim Rathkopf, Alexis Schach von Wittenau, and Rosemary Walling for the PEREGRINE radiation dose calculation system.

Many Significant Honors and Awards in 1999

Michael Key, Stephen Libby, Kennedy Reed, and Peter Young were named fellows of the American Physical Society.

Jeff Wadsworth was named a fellow of the Minerals, Metals, and Materials Society.

Charles Landram was named a fellow of the American Society of Mechanical Engineers.

Michael MacCracken was named a fellow of the American Association for the Advancement of Science for leadership in modeling climate and air quality and coordinating international research activities.

Richard Post received the *Popular Mechanics* Design and Engineering Award for 2000 for his invention of a new type of bearing—a passive magnet bearing—which may last longer than ball bearings or other magnetic alternatives.

Scientists from Livermore and a Russian laboratory were honored by *Chemical & Engineering News* and *Popular Science* for their joint discovery of a new element, element 114, which lasted 30 seconds before breaking down into lighter elements.

The 1999 Hammer Award was presented to Livermore's Hazardous Materials Packaging and Transportation Safety Assurance Office (represented by Ron Natali), as part of a group of DOE contractors, the Suppliers Quality Information Group, that share supplier assessment information to save money. This annual award is given by Vice President Al Gore's National Partnership for Reinventing Government.

Jim Jackson received the DOE Don Ross Industrial Hygiene Award in recognition of exceptional service and contributions to industrial hygiene programs.

Fusion Power Associates Leadership Award went to Grant Logan for his contributions in accelerating the development of fusion.

Robin Newmark and Roger Aines received the Environmental Protection Agency's Outstanding Remediation Technology Award, with collaborators at the University of California at Berkeley and Southern California Edison, for work in dynamic underground stripping and hydrous pyrolysis/oxidation.

David Cooper was reappointed by President Clinton to the President's Information Technology Advisory Committee.

Charles A. McDonald Jr. was awarded the U.S. Strategic Command's Strategic Advisory Group Distinguished Public Service Award for "exceptionally superior civilian public service" in monitoring the safety and reliability of the nation's nuclear stockpile.

The board of directors of the National Registry of Radiation Protection Technology bestowed its emeritus status on Paula Trinoskey.

The Federal Laboratory Consortium Award for Excellence in Technology Transfer was given to Abraham Lee, Duncan Maitland, Luiz Da Silva, Dean Hadley, Christopher Lee, Pat Fitch, Dan Schumann, and Jim Sommercorn. The award was given to the laser-activated microgripper that releases a coil inside a cerebral aneurysm and greatly reduces the risk of a hemorrhagic stroke.

Darleane Hoffman, formerly head of Livermore's Seaborg Institute, received the 1999 Priestly Medal of the American Chemical Society for her work in the chemical properties of heavy elements.

Steve Gray received the Defense Intelligence Agency's Director's Award for Exceptional Leadership in setting up on a classified, secure network a Web site that combines up-to-date information on foreign proliferation with computational tools and models.

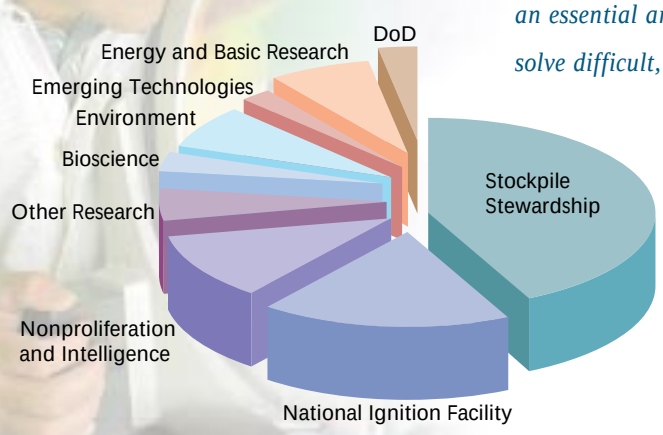
Steve Haan was named one of three 1999 recipients of the Edward Teller Award by the American Nuclear Society for his work in the design of inertial confinement fusion targets.

Jack Campbell received the 1999 Otto Shott Research Award of the European Society of Glass.

George Moorehead was named Livermore Chamber of Commerce's Helen Moody Volunteer of the Year.

About the Laboratory's People and Programs

Lawrence Livermore National Laboratory's principal asset is its quality workforce. Through a long association with the University of California, the Laboratory has been able to recruit a world-class workforce and sustain a tradition of scientific and technical excellence. With about 8,000 employees, Livermore has an essential and compelling core mission in national security and the capabilities to solve difficult, important problems.



FY 1999 Budget: $1.36 Billion

A Quality Workforce

The Laboratory seeks a highly talented, productive, motivated, flexible staff that is committed to Livermore's goals and reflective of the diversity of California and the nation. We strive for a work environment in which all employees can contribute to their fullest and feel valued for their role.

The Laboratory's programmatic achievements would not be possible without the dedicated, high-quality efforts of all employees. The Laboratory greatly values the outstanding scientific and technical achievements of its scientific, technical, and administrative staffs. Their breakthrough accomplishments are critical to the success of Livermore's programs and provide the foundation for future programs to meet national needs.

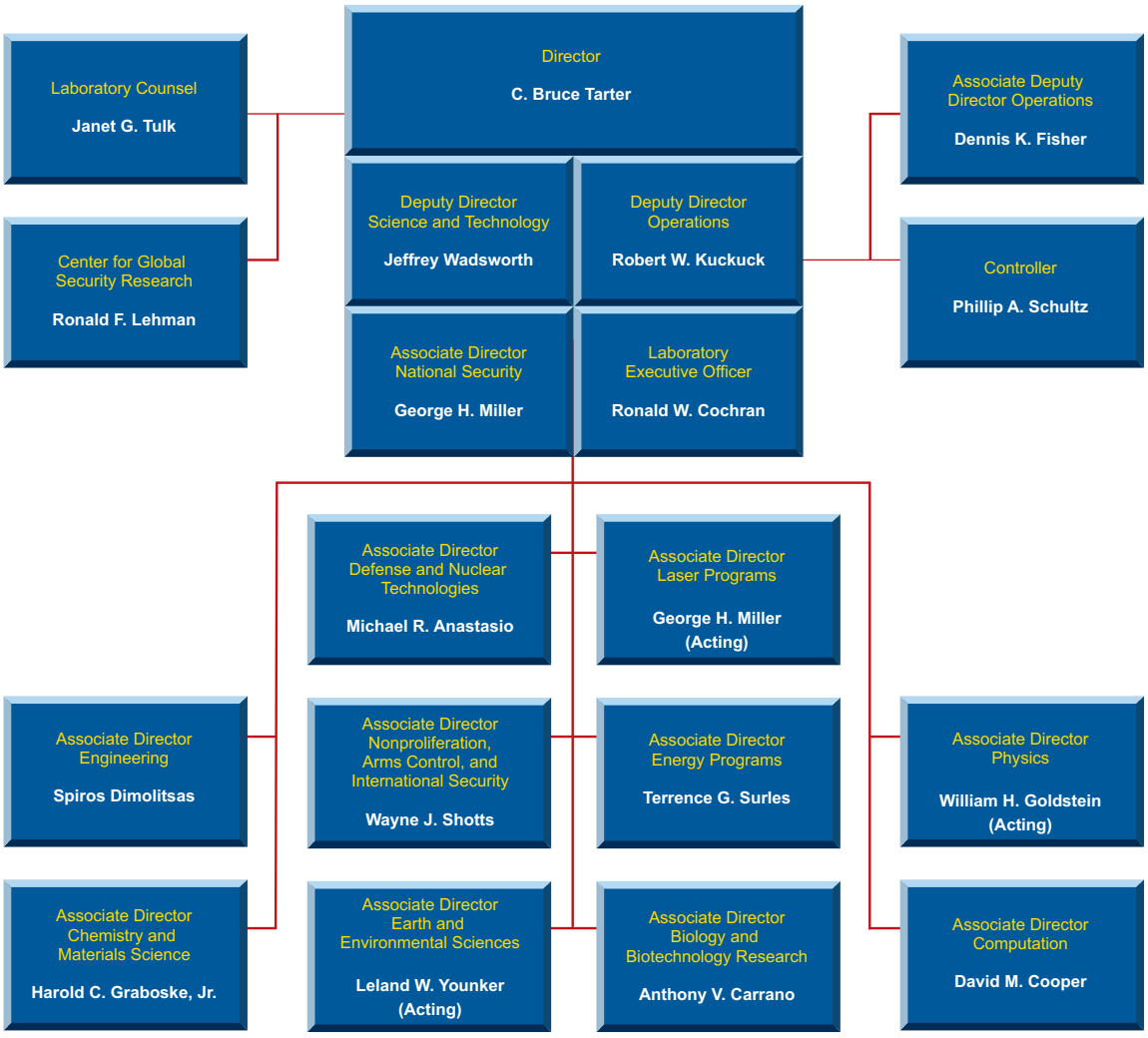
Laboratory Program Budget

Most of Livermore's $1.36-billion budget for fiscal year 1999 was designated for research and development in program areas supporting the Department of Energy's missions.

As a national security laboratory, we are part of DOE's National Nuclear Security Administration (NNSA). We receive most of our funding from the NNSA Office of Defense Programs for stockpile stewardship. We also receive funding from the NNSA Office of Defense Nuclear Nonproliferation, various Department of Defense sponsors, and other federal agencies for national security work.

As a multi-program laboratory, we apply Livermore's special capabilities to meet important national needs. Activities are pursued for other DOE programs, principally Environmental Restoration and Waste Management,

Lawrence Livermore National Laboratory Organization



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Fissile Material Disposition, Nuclear Energy, and Science. Non-DOE sponsors include federal agencies (such as the National Aeronautics and Space Administration, Nuclear Regulatory Commission, National Institutes of Health, and Environmental Protection Agency), State of California agencies, and industry.

Livermore Publications

Visit our Web site at http://www.llnl.gov/ to learn more about our many scientific and technical programs and to discover opportunities for employment, academic research, and industrial partnerships. Read about our accomplishments each month in *Science & Technology Review* on the Web or in print. Both *S&TR* and our *1998 Annual Report* were award winners in the Society of Technical Communication's 1999 international competition.

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